Claims:

1. A lithium ion battery which comprises a positive electrode and a negative electrode; said positive electrode having an active material represented by the formula $Li_aM'_{(2-b)}M"_bP_3O_{12-c}Z_c$, $0 \le b \le 2$, $0 < c < 12$, a is greater than zero and selected to represent the number of Li atoms to balance said formula; where M' and M" are the same or different from one another and are each elements selected from the group consisting of metal and metalloid elements; and where Z is a halogen.

2. The battery of claim 1 wherein the halogen is F (fluorine).

3. The battery of claim 1 wherein said active material is represented by the formula $Li_aM'_{(2-b)}M"_bP_3O_{12-c}F_c$; M' is selected from the group consisting of: V, Fe, Mn, and M" is selected from the group consisting of: V, Fe, Mn, Ti, Cr, Co, Ni, Cu, and Mo.

4. The battery of claim 1 wherein said active material is represented by one of the following formulas $Li_{2.0}M'_{(2-b)}M"_bP_3O_{11}F$; $Li_{2.5}M'_{(2-b)}M"_bP_3O_{11.5}F_{0.5}$; $Li_3M'_{(2-b)}M"_bP_3O_{11.5}F_{0.5}$; and $Li_3M'_{(2-b)}M"_bP_3O_{11}F$.

5. The battery of claim 1 wherein said positive electrode active material is selected from the group consisting of: $Li_{2.5}V^{3+}_{1.0}V^{3+}_{1.0}P_3O_{11.5}F_{0.5}$; $Li_{2.0}V^{3+}_{1.0}V^{3+}_{1.0}P_3O_{11.0}F_{1.0}$; $Li_{2.5}V^{3+}_{1.0}Mn^{3+}_{1.0}P_3O_{11.5}F_{0.5}$; $Li_{2.0}V^{3+}_{0.5}Fe^{3+}_{1.5}P_3O_{11.0}F$; $Li_3V^{2+}_{0.5}V^{3+}_{1.5}P_3O_{11.5}F_{0.5}$; $Li_3V^{2+}_{1.0}V^{3+}_{1.0}P_3O_{11.0}F_{1.0}$; $Li_3Mn^{2+}_{0.5}V^{3+}_{1.5}P_3O_{11.0}F_{0.5}$.

6. The battery of claim 1 wherein M' and M" are the same transition metal or are different transition metals.

7. The battery of claim 1 wherein at least one of M' and M" is selected from the group of transition metals.

8. The battery of claim 1 wherein M' and M'' are metals or metalloids independently selected from the group consisting of: V, Fe, Mn, Ti, Cr, Co, Ni, Cu, Mo, Al, Mg, Ca, B, Zn, Sn.

9. The battery of claim 1 wherein said positive electrode active material is represented by the formula $Li_3M'_{(2-b)}M"_bP_3O_{12-c}F_c$; M'and M" each have a valence state which is the same or different, where said valence state is +2 or +3.

10. The battery of claim 1 wherein said positive electrode active material is characterized by deintercalating lithium ions during charging cycle of said battery; said negative electrode active material characterized by intercalating said deintercalated lithium ions during said charging cycle, and by subsequent deintercalation of lithium ions during discharge cycle; and said positive electrode active material further characterized by reintercalating said discharge cycle lithium ions.

11. An electrochemical cell having an electrode which comprises an active material represented by the following formula:

$Li^{+1}_{(a-x)}$ $MI^{d}_{(2-b)}$ MII^{e}_{b} P^{+5}_{3} O^{-2}_{12-c} Z^{-1}_{c};

(A) where each superscript value represents the oxidation states of respective elements in a first condition, x = 0:

Superscript +1 is the oxidation state of one atom of Li (lithium),

Superscript d is the oxidation state of one atom of MI,

Superscript e is the oxidation state of one atom of MII,

Superscript -1 is the oxidation state of one atom of Z which is a halogen,

Superscript +5 is the oxidation state of one atom of P (phosphorus) and in the case of P_3 constitutes a total of 15,

Superscript -2 is the oxidation state of one atom of O (oxygen);

(B) MI and MII are the same or different and are each elements independently selected from the group of metal and metalloid elements;

(C) a, c, d and e are each greater than zero; d and e are each at least one; $0 \leq b \leq 2$; c is less than 12; and where a, b, c, d and e fulfill the requirement: $(a \times 1) + ((2 - b) \times d) + (b \times e) + 15 = (1 \times c) + ((12 - c) \times 2)$; and

(D) in a second condition represented by said formula with $0 < x \leq a$, and in said second condition, said oxidation state of MI is represented by d' and said oxidation state of MII is represented by e', said amount X of Li is removed from said compound, accompanied by a change in oxidation state of at least one of said MI and MII, according to $((2-b) \times (d'-d)) + (b(e'-e)) = X$; where $d' \geq d$ and $e' \geq e$; and where d, d', e, and e' are each less than or equal to 8.

12. The battery of claim 11 wherein the halogen is F (fluorine).

13. The cell according to claim 11 wherein d and e are each at least 2, $0 \leq b \leq 2$, and d, d', e, and e' are each less than or equal to 6.

14. The cell according to claim 11 wherein d, d', e and e' are each less than or equal to 7; and at least one of the following two conditions are met: (1) d' > d and (2) e' > e.

15. The cell according to claim 11 wherein MI and MII are each independently selected from the group consisting of: V, Fe, Mn, Ti, Cr, Co, Ni, Cu, Mo, Al, Mg, Ca, B, Zn, Sn.

16. An electrode having an active material in a first condition represented by the formula $Li_{3-x}E'_{(2-b)}E"_bP_3O_{12-c}F_c$, $x = 0$, $0 \leq b \leq 2$, $0 < c < 12$; where at least one of E' and E" is an element selected from the group consisting of metals and metalloids; and E' and E" are the same or different from one another; and in a second condition by said formula where $0 < x \leq 3$; and where at least one of E' and E" has an oxidation state higher than its oxidation state in said first condition.

17. An electrode which comprises an active material, represented by the nominal general formula $Li_aM'_{(2-b)}M"_bP_3O_{12-c)}Z_c$, $0 \leq b \leq 2$, $0 < c < 12$, a is greater than zero and selected to represent the number of Li atoms to balance said formula; where M' and M" are each elements selected from the group consisting of metal and metalloid elements, and said M' and M" are the same or different from one another; and where Z is a halogen.

18. The electrode of claim 17 wherein at least one of M' and M" is selected from the group of transition metals, and Z is F (fluorine).

19. The electrode of claim 17 wherein M' and M" are each independently selected from the group consisting of transition metals, and Z is F (fluorine).

20. An electrode which comprises an active material, represented by the nominal general formula $Li_aM'_{(2-b)}M"_bSi_yP_{3-y}O_{12-c}Z_c$, $0 \leq b \leq 2$, $0 < c < 12$, $0 \leq y < 3$, a is greater than zero and selected to represent the number of Li atoms to balance said formula; where M' and M" are each elements selected from the group consisting of metal and metalloid elements, and said M' and M" are the same or different from one another; and where Z is a halogen.

21. The electrode of claim 20 wherein at least one of M' and M" is selected from the group of transition metals, and Z is F (fluorine).

22. The electrode of claim 20 where a is 3.